NTSB
National Transportation Safety Board
490 L'Enfant Plaza, SW
Washington, DC 20594-0001
www.ntsb.gov

Report Date: May 5, 2006

Hazardous Materials Group Chairman's Factual Report

A. Accident Identification

Operator:	United Parcel Service Company (UPS)
Airplane:	DC-8-71F, N748UP
Location:	Philadelphia International Airport (PHL), Philadelphia, PA
Time/Date:	11:59 p.m. Eastern Standard Time (EST)
Date:	February 7, 2006
NTSB No.:	DCA06MA022

B. Hazardous Materials Group Members

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C. Accident Summary

On February 7, 2006, at 2359 eastern standard time, a Douglas DC-8-71F, N748UP, operated by United Parcel Service Company (UPS) as flight 1307, landed at Philadelphia International Airport (PHL), Philadelphia, Pennsylvania, after the crew reported a cargo smoke indication. The three crewmembers were able to evacuate the airplane using the L1 slide. The airplane later became engulfed in flames and was substantially damaged by fire. The three flight crewmembers received minor injuries. Night visual meteorological conditions prevailed and an instrument flight rules flight plan had been filed for the flight from Hartsfield-Jackson Atlanta International Airport (ATL), Atlanta, Georgia, to PHL. The scheduled cargo flight was conducted under 14 CFR Part 121.

D. Shipment Identification Effort

Based on forensic fire evidence identified on the fuselage and the main deck compartment area where the Unit Load Devices (ULD's) were positioned, the Fire/Cargo Group focused their investigation on the area in and around ULD numbers 12 and 13, which contained a total of 696 packages. Roughly 15 of these packages were identified as containing electronic items, such as laptop computers, that may or may not have contained batteries. The remainder of the items were identified as general freight consisting largely of clothing, food, machine parts, CD/DVD's, medical supplies, documents, computer parts, etc.

Efforts were made to contact the 233 shippers of these packages in order to identify their specific contents. This was accomplished by having a joint call group consisting of the NTSB, FAA, and a representative of UPS make contact with each shipper by telephone. As a result of these calls, 229 shippers were reached and were able to describe the contents of their package(s). Seven shippers could not be contacted. No contacted shipper stated that they shipped any items that would be regulated by the U.S. Department of Transportation (DOT) as a hazardous material, with the exception of lithium-ion batteries contained in laptop computers. One shipper did report shipping "rubber gasket material", which was likely the *neo-seal gasket cement* recovered from cargo debris in ULD 13 (see Section F), but made no mention of any hazardous material.

ATTACHMENT 1 – CONTENTS OF PACKAGES CONTAINED IN ULD NUMBERS 12 & 13

E. Examination of Cargo Debris

Examination of the cargo debris from UPS flight 1307 was completed in two phases. The initial phase was conducted as part of the on-scene investigation between February 9th and February 14th, 2006, and included the examination of cargo debris from all fire-damaged ULD's. The subsequent phase of the examination took place during a follow-up visit to Philadelphia, PA from March 14th to 15th, 2006, and focused specifically on the cargo debris found in ULD's 11, 12, 13, and 14 only.

Two declared packages of hazardous materials were recovered during the initial phase of cargo debris examination; both were found completely intact. Several additional items also containing hazardous materials were discovered over the course of the examinations, most of which were undamaged. The damage that was incurred by these items was external, resulting from exposure to fire and heat. No aerosol cans, broken bottles, containers, cylinders, or items of interest were found amongst the debris. Please refer to Section F for further details and documentation on these items.

A number of damaged and undamaged electronic items were recovered during the initial phase of cargo debris examinations, several of which contained internal power sources. Several of these items were transported back to the NTSB materials laboratory in Washington, D.C. for further documentation and more detailed examination. Some of the most notable items in this group included laptop computers of various makes and models, lithium and lithium-ion batteries/battery packs (some loose), and an uninterruptible power source. During a subsequent re-examination of the fire-damaged debris contained in ULD numbers 11, 12, 13, and 14, another laptop computer and several more lithium-ion battery cells were discovered and, like the others, brought back to the NTSB materials laboratory where they would also undergo more detailed examination. A total of thirty-four items were sent back to the NTSB materials laboratory.

Once the items arrived at the NTSB materials laboratory each item was photographed and its "as-is" condition was fully documented. Following the documentation phase of the inspection each item underwent detailed examination, where select items were taken apart to so that the interior components could be examined. Comprehensive information on the examination process and all relevant findings are documented in the *Fire/Cargo Group Chairman's Factual Report*.

ATTACHMENT 2 – ITEMS SENT BACK TO NTSB HEADQUARTERS

F. Hazardous Materials

Declared Items

Two declared packages of hazardous materials were onboard UPS-operated flight 1307 (TABLE 1). Both items were recovered intact from amongst the cargo debris, and neither released its contents or was damaged in any way. UPS provided hazardous materials forms (shipping papers) for each of these items and material safety data sheets (MSDS) were obtained from the respective shippers for product and hazard identification purposes.

ULD Position	*Hazard Class/Div*	*Chemical Ingredient*	*Container Info*			*Product Name*
			Qnty	*Size*	*Type*	
3	3	2 Heptanone	1	1L	-	N-amyl methyl ketone
14	6.1	Trichloroethylene	5	8lb	-	Consumer commodity

TABLE 1: DECLARED HAZARDOUS MATERIALS

N-amyl methyl ketone: The chemical name for this product is **2 heptanone**. When transported in its pure state, **2 heptanone** is regulated as a Class 3 flammable liquid. It was located in a full-width ULD situated in position 3[1], and was packaged in a DOT-authorized fiberboard box[2] with a "flammable" label affixed.

Consumer commodity[3]: This type of product is regulated by DOT as an ORM-D (other regulated material). This particular product is a vulcanizing compound that contains **trichloroethylene**, which is a Division 6.1 poisonous material. It was located in a full-width ULD situated in position 14, and was packaged in a DOT-authorized fiberboard box with a "Consumer Commodity ORM-D-AIR" label affixed.

UPS records also indicate that 115.3 lbs of Carbon dioxide, solid, or Dry ice, a DOT regulated Class 9 commodity, was loaded in the ULD situated in position 8 and an additional 10 lbs was located in position 33.

ATTACHMENT 3 – UPS HAZARDOUS MATERIALS FORMS (SHIPPING PAPERS)
ATTACHMENT 4 – MSDS (ABACO INC.): N-AMYL METHYL KETONE
ATTACHMENT 5 – MSDS (REMA TIP TOP): 74A & 74B VULCANIZING COMPOUND

PHOTOGRAPH 1 – N-AMYL METHYL KETONE, OUTER PACKAGING
PHOTOGRAPH 2 – CONSUMER COMMODITY, OUTER PACKAGING
PHOTOGRAPH 3 – CONSUMER COMMODITY, INNER CONTAINERS

Undeclared Items

The items listed in TABLE 2 were discovered upon examination of cargo debris. The NTSB obtained appropriate MSDS for these items for product and potential hazard identification. All of these items were found completely intact, with the exception of the uninterruptible power source and plastic nail polish remover bottles.

[1] Refers to the third compartment behind the cockpit on the main deck.

[2] The fiberboard box is the outer packaging. Regulations require hazardous liquids to be contained in inner containers made of glass, plastic, earthenware, or metal depending on the material.

[3] Consumer commodity means any material that is packaged and distributed in a form intended or suitable for sale through retail sales agencies or instrumentalities for consumption by individuals for purposes of personal care or household use. This term also includes drugs and medicines. (49CFR 171.8)

ULD Position	Hazard Class/Div	Chemical Ingredient(s)	Container Info			Product Name
			Qnty	Size	Type	
11	8	Sulfuric acid	1	-	-	Uniterruptible power source
13	3	Tolulene, MEK, acetone	5	.75oz	Tube	Neo-seal gasket cement
14	2.1	Butane	1	-	-	Flexible utility lighter w/ butane refill
17	3	Acetone	3	4oz	Plastic	Extra strength nail polish remover
17	3	Acetone	6	16oz	Plastic	Gentle strength nail polish remover
17	*Unknown*	*Unknown*	5	8oz	Plastic	Polish remover

TABLE 2: UNDECLARED HAZARDOUS MATERIALS

Uninterruptible power source: This item contains a **lead acid battery**, which according to the MSDS contains 14% by weight electrolyte or sulfuric acid. The battery therefore falls under the "battery, wet, filled with acid" category, which is regulated by the DOT as a Class 8 corrosive material. The item was found relatively intact, with the exception of its outer casing, which was partially melted as a result of exposure to the heat and/or fire.

Neo-seal gasket cement: This product contains **toluene, methyl ethyl ketone (MEK),** and **acetone;** all three of these materials are regulated by the DOT as Class 3 flammable liquids. These items were undamaged.

Flexible utility lighter with butane refill: This product contains **butane**, which is regulated by the DOT as a Division 2.1 flammable gas, both within the lighter and the refill unit. These items were undamaged.

Nail Polish remover: According to the MSDS, the primary ingredient in both the extra and gentle strength formulas is **acetone,** which is regulated by the DOT as a Class 3 flammable liquid. All of the plastic bottles containing the polish remover were moderately melted as a result of exposure to the heat and/or fire.

Unidentified polish remover: A MSDS for this product could not be obtained and its chemical contents could not be determined. The plastic bottles containing the product were mostly melted as a result of exposure to the heat and/or fire.

The DOT provides certain exceptions for limited quantity shipments of the following classes/divisions of hazardous materials: Class 3 (flammable liquids), Division 4.1 (flammable solids), Division 4.3 (dangerous when wet), Division 5.1 (oxidizers), Division 5.2 (organic peroxides), Division 6.1 (poisonous materials[4]), Class 8 (corrosive materials), and Class 9 (miscellaneous hazardous materials). These exceptions are applicable only when the materials are shipped in "a combination of packaging… consisting of one or more inner packagings secured in a non-bulk outer packaging[5]", where the inner packagings do not exceed specified capacities, and the gross weight does not exceed 30.0kg. Limitations placed on net capacities of individual inner packagings range anywhere from 125mL to 5.0L for

[4] These exceptions do not apply to poison-by-inhalation (PIH) materials.

[5] 49CFR 171.8

liquids, and 1.0kg to 5.0kg for solids, depending on the hazardous class and packing group assignment. Accordingly, limited quantities of such materials are excepted from placarding requirements in all modes of transportation, and from all labeling requirements, unless offered or intended for air transport.

In the case where a limited quantity of such material both conforms with the requirements mentioned above and is by definition a consumer commodity, meaning that "it is packaged and distributed in a form intended or suitable for sale through retail sales agencies or instrumentalities for consumption by individuals for purposes of personal care or household use[5]", the material may be renamed "consumer commodity", reclassified as ORM-D material, and be privy to all exceptions aforementioned. When a material is reclassified as ORM-D, the 30kg gross weight limitation is no longer applicable provided that the inner packagings comply with the net capacity restrictions established, and specification packaging is not required. Packages containing consumer commodities are not required to have hazardous materials labels; however, they are required to be marked with the proper shipping name followed by the "ORM-D" designation. Shipping papers are not required for the transport of ORM-D, unless offered or intended for transportation by air.

Thus all the undeclared items recovered from the cargo debris, with the exception of the flexible utility lighter containing butane (Division 2.1 flammable gas), would be classified as "ORM-D consumer commodities". According to UPS records, none of these items were known hazardous materials shipments.

ATTACHMENT 6 – MSDS (CSB BATTERY OF AMERICA CORP.): LEAD ACID BATTERY
ATTACHMENT 7 – MSDS (ZURN INDUSTRIES): NEO-SEAL GASKET CEMENT
ATTACHMENT 8 – MSDS (BERNZ-O-MATIC): BUTANE
ATTACHMENT 9 – MSDS (ORLY INTERNATIONAL): EXTRA STRENGTH POLISH REMOVER
ATTACHMENT 10 – MSDS (ORLY INTERNATIONAL): GENTLE STRENGTH POLISH REMOVER

PHOTOGRAPH 4 – UNINTERRUPTIBLE POWER SOURCE
PHOTOGRAPH 5 – NEO-SEAL GASKET CEMENT
PHOTOGRAPH 6 – FLEXIBLE UTILITY LIGHTER WITH BUTANE REFILL
PHOTOGRAPH 7 – ORLY EXTRA STRENGTH POLISH REMOVER
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PHOTOGRAPH 9 – POLISH REMOVER

Electronic equipment

A number of lithium-ion batteries were found in laptop computers, cellular telephones, and otherwise amongst the debris. The laptops involved in the fire contained the largest lithium-ion batteries of all the electronic equipment examined. Although the examination of these laptops did not reveal the name of the manufacturer, a search of several Internet websites revealed that manufacturer-installed lithium-ion batteries in Dell, Gateway, Compaq, and NEC laptops consist of anywhere between 3 and 12 lithium-ion cells.

DOT regulations on lithium batteries are based on the amount of metallic lithium contained in the battery itself as well as in each individual battery cell, or internal component. In the case of lithium-ion batteries, which contain no metallic lithium, 49CFR 173.183(a), provides a method for calculating "equivalent lithium content" in these batteries. The equivalent lithium content, in grams (g), is calculated to be 0.30 times the battery or cell phone's rated capacity in ampere-hours (amp-hrs). The lithium-ion battery capacities found during the Internet search ranged anywhere from 1.8 to 6.6 amp-hrs. Given the maximum battery capacity identified in the search, a 6.6 amp-hrs lithium-ion battery contains the lithium equivalent of 1.98 g (6.6 x 0.3 = 1.98). Each of the laptop batteries damaged and examined by the Fire Group contained 6 cells.

"Lithium batteries, contained in equipment", including equipment containing lithium-ion batteries, such as laptop computers, are regulated by the DOT as Class 9 miscellaneous regulated materials. Their shipping requirements are found in 49 CFR 173.185. Under 49CFR 173.185 lithium-ion batteries contained in equipment are exempted from all of the requirements of the Hazardous Materials Regulations (packaging, marking, labeling, shipping papers, and etc.) provided that each lithium-ion cell contain no more than 1.5 g of equivalent lithium content, and that the battery contain no more that 8.0 g of equivalent lithium content. This exception covers the entire range of batteries used in laptops identified in the Internet search above.

G. History of Battery-related Incidents

According to information provided by the Federal Aviation Administration (FAA) in the document titled; *Batteries & Battery-Powered Devices: Aviation Incidents Involving Smoke, Fire or Explosion*, in the ten years preceding the UPS flight 1307 accident, a total of 59 incidents directly related to batteries have occurred in the aviation industry. The types of batteries involved in these incidents included lithium, lithium-ion, lead-acid, metallic and others. The frequency of their involvement can be seen in the distribution chart below. (CHART 1) The data shows that more than three-quarters (78%) of all battery-related aviation incidents occurring in the last 10-years were caused by lead-acid, metallic and other batteries, whereas lithium and lithium-ion batteries are attributed to the remaining 22%.

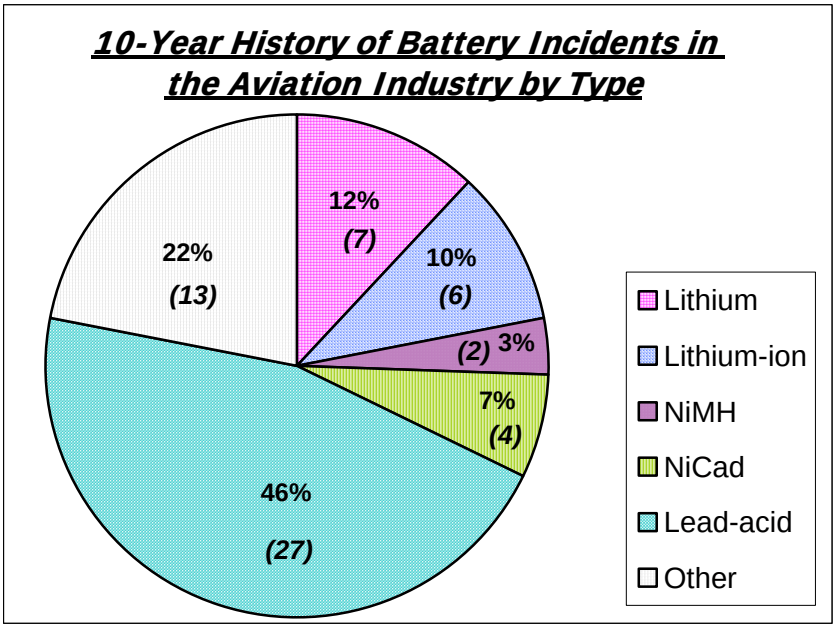

CHART 1: 10-YEAR HISTORY OF BATTERY INCIDENTS IN THE AVIATION INDUSTRY BY TYPE

Of the 59 total battery-related incidents, 42 involved items shipped on cargo-designated aircraft, 15 involved checked baggage and carry-on items intended for passenger flights, and the remaining 2 involved items shipped as cargo onboard passenger aircraft. Of the 42 incidents involving cargo-designated aircraft, 37 occurred post-flight, either during unloading or sorting operations, or while on a truck out for delivery; 4 occurred or were detected prior to the items' being loaded onto the aircraft; and only 1 occurred in-flight causing the aircraft to divert and land. Roughly 57% or 24 of these incidents were reportedly found to be the direct result of the electronic items short-circuiting, caused in part by improper packaging. Several others resulted from the accidental activation of battery-powered devices or tools contained in shipments, which generated heat and resulted in fires. Only one incident was reportedly attributed to mishandling of an item.

All of these incidents resulted in smoke, fire, explosion, or some combination of the three. Although no loss of life has occurred, roughly 10 injuries of varying degrees have been reported.

Breaking the ten years of data down into two consecutive five-year periods, the first from 1996-2000 and the second from 2001-2006, shows a drop in the overall number of incidents in the past five years from 34 to 25 incidents (CHART 2). However, this arrangement of data also illustrates that aviation incidents involving both lithium and lithium-ion batteries are on the rise. From 1996-2000, these types of batteries accounted for a combined 12% of the total number of battery-related incidents, whereas in more recent years, 2001-2006, they were attributed to 36% of total incidents.

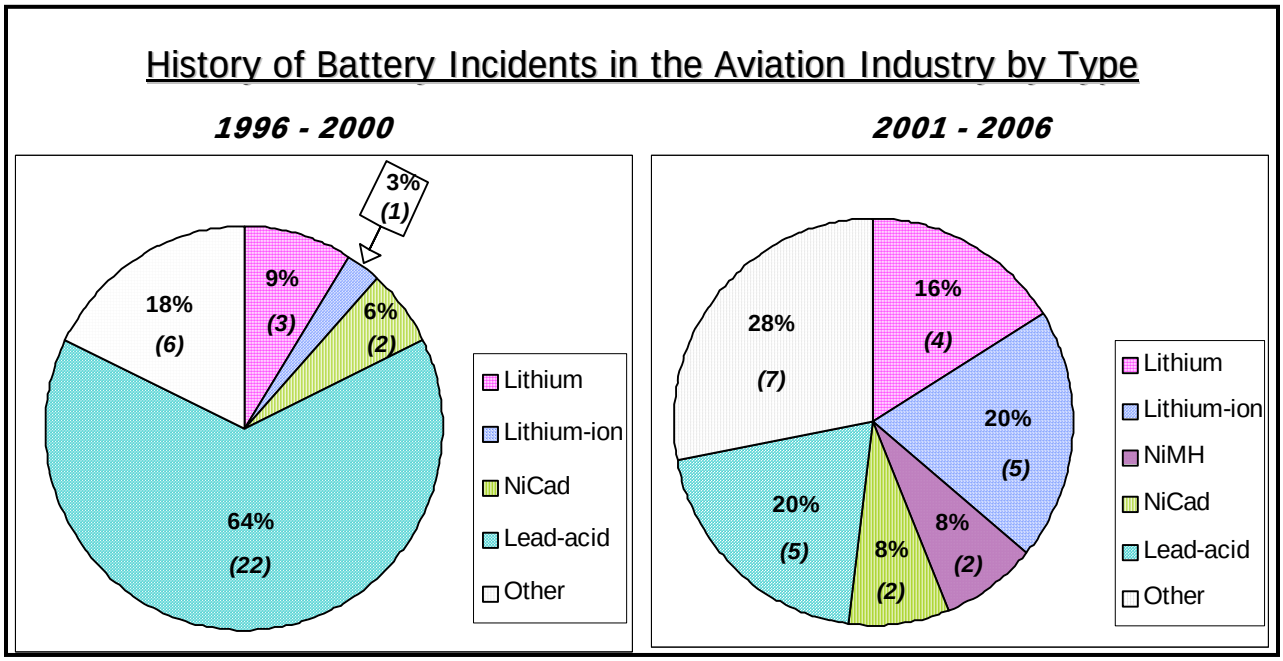

CHART 2: HISTORY OF BATTERY INCIDENTS IN THE AVIATION INDUSTRY BY TYPE

ATTACHMENT 11 – BATTERIES & BATTERY-POWERED DEVICES: AVIATION INCIDENTS INVOLVING SMOKE, FIRE OR EXPLOSION

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